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Integration of Multiple Stakeholders in Scientific Research: A Sensemaking-Sensegiving Approach

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Abstract: This paper argues that senior scientists in the area of nanoscience and nanotechnology build a new vision of their research activity in order to encompass multiple stakeholders such as policy makers, funding agencies and PhD students. Through a qualitative and inductive study and the lens of sensemaking and sensegiving, we show that senior scientists shape new boundaries in order to make the new vision visible to both internal and external stakeholders. Finally, they engage in sensemaking and sensegiving on a daily basis in order to adapt and sustain their activity over time.

Keywords: sensemaking, sensegiving, process, materiality, nanoscience and nanotechnology

INTEGRATION OF MULTIPLE STAKEHOLDERS IN SCIENTIFIC RESEARCH: A SENSEMAKING SENSEGIVING APPROACH

INTRODUCTION

Science has undergone drastic changes since World War II with a greater involvement of governments and industries in the production of scientific knowledge (Leydersdorff and Etzkowitz, 1998). Moreover, the shift from recurrent to project funding (Braun, 1998) has made scientists more dependent on external funding (Laudel, 2006). However, they still have to produce a scientific outcome that has to be recognised by the scientific community and to train PhD students to scientific research. In this pluralistic context (Jarzabkowski and Fenton, 2006), the study of micro-actions and the 'doing of strategy' – how senior scientists are organising their activity – becomes relevant in order to understand how they integrate these multiple stakeholders into their daily activity. Sensemaking and sensegiving (Gioia and Chittipeddi, 1991) are suited to this level of analysis (Rouleau, 2005).

We based our study on qualitative and inductive research with six senior scientists in the area of nanoscience and nanotechnology (N&N). This fieldwork is particularly suited as this emerging area is characterised by an involvement of multiple scientific disciplines (Heinze et al. 2007); a dependence on external funding (Laudel, 2006) and finally; massive funding poured over the past decades (Roco, 2005). Through this study, we show that by identifying different opportunities – either from policy makers or the scientific community – senior scientists create a new broad vision in order to align and encompass the multiple stakeholders within their research activity. This vision is materialised by the construction of new boundaries such as a laboratory or a research centre that make the new entity visible towards both external – policy makers and funding agencies – and internal – PhDs students – stakeholders. Funding agencies are not only influencing the strategy of the research team but are part of it. These changes do not occur only at the creation of the new entity but are engaged on daily basis in order to adapt the activity to the environment and to sustain it over time.

The paper is organised as follows. First, we present the characteristics of pluralistic contexts and the challenges they raise, as well as the two processes of sensemaking and sensegiving. Second, we describe the six cases and the qualitative and inductive research used in order to investigate them. Third, we develop our results and detail the three categories within which

practitioners are engaged. Finally, we discuss the consequences of these changes on scientific research.

SENSEMAKING, SENSEGIVING AND PLURALISTIC CONTEXTS

Pluralistic contexts

Pluralistic contexts are characterised by multiple objectives, diffused power and knowledge-based work processes (Denis et al., 2007). As highlighted by the recent Strategy as Practice stream of research, by challenging the traditional view of strategic management (Denis et al., 2007), pluralistic contexts are of particular interest as they raise a number of challenges, such as the realisation by practitioners of simultaneously conflicting goals (Jarzabkowski and Fenton, 2006). Strategy as practice refocuses the attention to the micro-actions in order to deepen how individuals are actually doing strategy, instead of what the strategy of the organisation is (Jarzabkowski et al., 2007). In this way, practitioners are an essential unit of analysis, as they are the main actors in the construction of an organisation and its survival, and, through their actions, they shape the activity 'through who they are, how they act and what resources they draw upon' (Jarzabkowski et al., 2007).

Within pluralistic contexts, the actions of practitioners are constrained by a number of different actors that are outside the organisation, but have an influence on the strategy and the activity (Jarzabkowski et al., 2007). These actors can be either in direct relation to the organisation, such as consultants and customers, or have an indirect influence, such as institutional actors, regulators and interests groups (Whittington, 2006). Including these external actors in the study is particular important in order to understand how they are included in the strategy and in the present case, how a senior scientists includes these actors in the strategy of his research activity.

Sensemaking and sensegiving in pluralistic contexts

Sensemaking and sensegiving are particularly suited to studying the day-to-day actions of practitioners and how practitioners construct and change the strategy (Rouleau, 2005). Since Gioia and Chittipeddi's (1991) seminal paper, the processes of sensemaking and sensegiving have been deepened by different studies, such as identity change during a corporate spin-off (Corley and Gioia, 2004), change of sensemaking schema during an organisational restructuring (Balongun and Johnson, 2004), or narrative change during an economic reform

(Dunford and Jones, 2000). Gioia and Chittipeddi (1991: 442) describe *sensemaking* as the 'meaning construction and reconstruction by the involved parties as they attempt to develop a meaningful framework for understanding the nature of the intended strategic change'. This activity is thus related to an interpretation of events and their implications (Dunford and Jones, 2000). *Sensegiving* is defined as the 'process of attempting to influence the sensemaking and meaning construction of others toward a preferred redefinition of organisational reality' (Gioia and Chittipeddi, 1991: 442). More generally, Gioia's research (Gioia and Chittipeddi, 1991; Gioia and Thomas, 1996) has emphasised how top managers make sense of the environment and try to influence others' meaning construction (Maitlis and Sonenshein, 2010).

Although sensemaking and sensegiving enlighten day-to-day practitioners' practices, the literature lacks understanding about how these two interrelated concepts are embedded in materiality. Indeed, in the study of practices, Orlikowski (2007: 1436) highlights 'absence of any considered treatment or theorizing of the material artifacts, bodies, arrangements, and infrastructures through which practices are performed'. So, applying this theoretical framework to a scientific activity gives the opportunity to make it comparable to other industries. Within this frame, we ask the following twofold research question: How do senior scientists who lead a research team make and give sense in a pluralistic context? How do they materialise these processes in their day-to-day practices?

METHODOLOGY

Research Setting and Research Design

In order to answer our twofold research question, we focus our study on senior scientists who lead teams in the area of nanoscience and nanotechnology. This fieldwork is particularly suited for the study as this emerging area is characterised by an involvement of multiple scientific disciplines (Heinze et al. 2007) that are more or less overlapping (Meyer, 2001). Moreover, with the shift from recurrent to competitive funding, researchers are more and more dependent on external funding (Laudel, 2006). Related to this point, this area of nanoscience and nanotechnology has benefited from massive funding over the past decades (Roco, 2005). Finally, as PhD students are part of the research teams, senior scientists also have to organise the work in order for these students to obtain their doctoral degree in a defined amount of time.

This study has been undertaken in the Republic of Ireland for two main reasons. First, as this is a rather small, geographically bounded country, the stakeholders are easily identifiable. This enables us to have a fair picture of the area of nanoscience and nanotechnology and of the different actors – scientists and their teams, policy makers and funding agencies – that are involved in this area. Second, strong science and technology policy and nanoscience and nanotechnology programmes have enabled the research infrastructures to be developed across the country and the level of funding is in line with leading countries such as Germany.[1] Moreover, in terms of publication and patent rankings, Ireland is among the main European countries that produce over 60 per cent of the publications in nanoscience and nanotechnology in the Science Citation Index (Heinze, 2004).

A comparative case study (Eisenhardt, 1989) has been undertaken in order to answer our research question. Jarzabkowki and Spee (2009) explain that a comparative case method is particularly suited to describe the variations in what leaders do in order to explain how activities are built. See Table 1 for the presentation of the six study cases: Alpha, Beta, Gamma, Delta, Epsilon and Omega.

< Please insert table 1 about here >

Data Collection

Team leaders were identified through their publications answering criteria set out in Mogoutov and Kahane (2007) and confirmed by the journals falling into the nanoscience and nanotechnology category from Thomson Reuters ISI Web of Knowledge. The sample that was chosen is not representative of the area of nanoscience and nanotechnology, but was built through different criteria, such as a mono- and multidisciplinary environment, experimental or theoretical work, and the creation or not of a new entity advertising itself as nanoscience and nanotechnology. These criteria enabled us to identify a larger range of external stakeholders, to include policy makers and funding agencies.

The identification of the internal and external stakeholders (See Table 2 for the presentation of the external stakeholders) was not predetermined (Maitlis and Lawrence, 2007). The data collection followed three main steps. First, once the team leader was identified, documents

[1] Forfás. 2010. Ireland's Nanotechnology Commercialisation Framework 2010-2014.

through websites and newspaper articles were gathered in order to have some pre-information about the team, its research and how it is promoted. Then, for each case, a preliminary interview was carried out with the team leader in order to have a deeper understanding of the research specialty (Chubin, 1976), the reasons why and how the team has been built, and what goals it tends to pursue, everyday functioning of the group such as the different projects that are currently being conducted and by whom, the different collaborators within and outside the team, if any, and the different sources of funding.

< Please insert table 2 about here >

Second, interviews were conducted with the postdoctoral research and senior PhD students. Junior PhD students were not the priority in this study as they are in the exploratory phase of their project and tend to have a limited view of their research area. Interviews with the postdoctoral researchers and the senior PhD students focused on their project, the conferences they are going to, the journals they have published in or the ones they are targeting, their collaborators, and their understanding of the speciality of the area and how it relates to nanoscience and nanotechnology.

Finally, documents from each funding agency (annual reports, calls for proposals, and action plans) were gathered in order to characterise the integration of N&N in policy markers' policy and the evolution of it over time. Data collection was completed with interviews with the main actors of each funding agency. Then, a last round of interviews was conducted with the senior researchers in order to discuss their strategy to fund their research and how they reconcile the objectives established by the funding agencies, their production of a scientific outcomes and the education of PhD students.

Data Analysis

We based our study on a qualitative, inductive approach (Strauss and Corbin, 2007) and followed for the data analysis over three stages (Maitlis and Lawrence, 2007). First, for each case, we built a narrative that described the sensemaking and sensegiving processes related to the pluralistic contexts and the main actions of practitioners to sustain the research activity: collecting funding, producing scientific outcomes, and training PhD students. These narratives are made of raw data from documents, quotes from the interviews, and notes that have been

taken after each interview. Each of these narratives describes the creation and the evolution of the research team, the scientific interests, the relation to the area of nanoscience and nanotechnology when the funding has become more important, and how the practitioners' actions are realised to sustain the team (gathering funding), produce scientific outcomes and train PhD students.

Second, we identify the actions through which the senior scientists make sense of and give sense to their pluralistic environment and how these actions are related to the internal (PhD students) and external (funding agencies and policy makers) stakeholders. In this stage, information about the justification of the research activity, the constraints they experience and the different funding sources was crossed with the documents and quotes from the interviews conducted with the funding agencies and policy makers.

During the last stage, we focused on answering the research question: how practitioners make sense and give sense in a pluralistic environment and how they materialise these processes in their day-to-day praxis. We first identified twenty different actions – first order concepts – related to the activity of finding funding, producing a scientific outcome, and training PhD students. We then built up more abstract categories by combining first-order concepts into six sets of second-order concepts. The third step identified the main actions related to sensemaking and sensegiving in which senior scientists engage in their day-to-day activity. The last step was to identify the links between these categories.

FINDINGS

Aligning, materialising and diffusing the sense through the activity

Aligning stakeholders within a new vision. Due to the lack of recurrent funding, researchers become more and more dependent on external funding and, therefore, on actors such as funding agencies. So, at a national and supra-national (European) level, team leaders have to find a way to fit their research to the different calls for funding in order to sustain their activity. Ireland has invested a lot into the area of nanoscience and nanotechnology through the construction of research infrastructures and the funding of projects in this area. Although researchers benefited from a favourable funding environment, with recognition by policy makers of the scientific, economic and social potential of nanotechnology through the creation

of a task force[1] in 2003, the global economic crisis has meant the funding agencies have had to reduce the amount of funding in science and technology in general and undertake a prioritisation of the research down to certain specific areas. The economic downturn meant the policy makers, and thus the funding, favoured projects with economic potential; in other words, projects closer to technological applications. In this context of reduced resources, researchers have to relable or adapt their research in order to be aligned with the stakeholders. Researchers that undertake the construction of a global vision, which encompasses both the policy directions and tackling new avenues of research, have been the most successful in attracting funding.

This success gave the opportunity to *Alpha* and *Delta* to buy equipments that enable the laboratory to develop its research. *Beta*, *Epsilon* and *Omega* did not completely build a new vision of their research activity embedded in the area of N&N and kept on seeing their research as basic and therefore not directly applicable. This choice made them very dependent on their funding and did not enable them to renew their aging equipment.

Materialising the new vision. The new vision is materialised, first, by the creation of new boundaries through the creation of a new research centre (*Delta*) or of an entity within an existing centre (*Alpha* and *Gamma*). In the case of *Alpha*, the construction of a new laboratory within a research centre was made through the recombination of internal resources (both equipment and personnel) in order to gather the research around the same focus. The creation of a new entity (name, geographical location in the building, and expertise) enabled the individuals to claim their membership of this new laboratory and made them experts of specific techniques or pioneers in an area that was undefined beforehand. In the case of *Gamma*, the materialisation of the vision is through the development of software, more specifically, a code that enables scientists, but also companies, to make simulations of the electrical properties of different atoms. The development of the code is central to the activity of *Gamma*. PhD students and postdocs tackle different aspects of its development: theoretical foundation of the code, improvement of the simulation with different types of atom, and writing of the code. The *Delta* research team develops the understanding of nanoparticles to use them, for instance, as a carrier in order to cure disease. This type of research has some potential to improve cures for cancer by drastically reducing the amount of medication. The construction of the research centre has enabled *Delta* to gather funding in order to construct

[1] Forfás. Annual Report 2003.

the building and buy equipment. *Beta*, *Epsilon* and *Omega* did not engage in the construction of new boundaries that would enable them to claim a research area in line with societal needs. These three research team leaders, especially *Beta's,* emphasise their role as academics to train PhD students in scientific research. By focusing on this aspect, writing grant proposal is not fully integrated in the activity of the team.

Diffusing the new vision to stakeholders. In the three cases of *Alpha*, *Gamma* and *Delta*, diffusing the new vision to external stakeholders is made through websites, the scientific recognition of their research – publications, conferences, and invited talks – and the justification of their research in documents such as grant proposals. *Alpha* and *Gamma* have seen team size reaching a point where bringing more individuals into the team would be unsustainable. *Delta* are also successful in attracting funding and the number of individuals in the group has been growing over the past few years. However, as their main project was to build a research centre, it has been slowed down given the lack of funding. *Beta*, *Epsilon* and *Omega* experience more difficulties diffusing their research to external stakeholders. As no new vision has been created, influencing external stakeholders is more difficult. *Beta* and *Omega's* leaders are developing partnerships either with industry or recognised groups in order to improve their chances of getting funding. As his research is basic, *Omega's* leader tries to find a way to apply his research area to trendy topics that are fostered by policy makers such as energy.

< Please insert Figure 1 about here >

Sensemaking and sensegiving as intertwined processes

This section tackles the links between the three main categories developed above. By focusing on team leaders and their day-to-day activity, we saw in the first section that their actions are highly influenced by the external – policy makers, funding agencies and the scientific community – and internal – PhD students – stakeholders. In order to sustain their activity, they engaged in a sensemaking process in order to create a new vision that would encompass both external and internal stakeholders. Through this process, and by shaping their new vision with boundaries, they are able to influence all stakeholders with a coherent activity. Within a pluralistic and fast changing environment, sensemaking does not occur only before the creation of a new boundary and sensegiving in order to achieve the vision. In a dynamic

environment, team leaders engage in sensemaking and sensegiving on a daily basis in order to constantly adapt their activity to the environment. *Alpha* presents a good illustration of this point. Indeed, before the creation of the lab, the purpose of the research was to hire people able to characterise the nanoparticle and others able to study their toxicity. To do so involved engaging individuals with a background in physics or chemistry on the one hand, and individuals with a background in biology or toxicology on the other. Within a short space of time, all individuals were converging towards a type of research that combines both physical and biological aspects. This convergence enabled the lab to adapt each project to different calls for proposals by emphasising one aspect or another, for example, recently raised concerns about nanoparticles in food such as in packaging. As they already have expertise in studying the movement of nanoparticles with spectrometry techniques, they have been able to transpose these techniques to food packaging. After an exploratory phase with one PhD student, more PhD students have recently been hired and *Alpha* has become a visible entity throughout the country on this topic.

< Please insert Figure 2 about here >

DISCUSSION

Through the lens of sensemaking and sensegiving, we asked the following twofold research question: How do practitioners make and give sense in a pluralistic context? How do they materialise these processes in their day-today praxis? We showed that senior scientists create a new vision in order to align both internal and external stakeholders in their research activities. By materialising this vision through new boundaries, techniques and expertise, senior scientists are most likely to sustain their activity and to make it visible in an environment characterised by multiple stakeholders. Senior scientists are not engaged in sensemaking only before the creation of new boundaries but in their daily actions in order to adapt their activity to the environment. This influences the sensegiving process and makes the two interrelated. These two processes are important in the understanding of scientific research nowadays. The discussion is based on two points: (1) the organising of scientific research within a pluralistic context and (2) how senior integrate multiple stakeholders on a daily basis.

1. N&N is characterised by multidisciplinarity (Heinze et al., 2007) and, as with other scientific disciplines, by a dependence on external funding (Braun, 1998; Laudel, 2006).

Senior scientists have now to deal with multiple goals such as getting funding, being recognised in the scientific community and training PhD students to scientific research. These goals can be conflicting and the research activity has to be constantly adapted to fit the requirements of the funding agencies. By creating new boundaries, they create a new entity – a laboratory, a team or a research centre – that encompasses the requirements from the funding agencies, the research community and the training of PhD students.

2. The shaping and reshaping process enables senior scientists first to be visible towards each stakeholder and second to adapt their research activity by integrating new resources to their entity around a core expertise or knowledge. Sensemaking and sensegiving are materialised by the integration of new resources (equipments), new projects (PhD students with different backgrounds), and interactions with stakeholders that were not influencing the strategy in the first place (new funding agencies). These processes are not only engaged at the creation of the new entity but also in day-to-day adaptations. This is essential in the study of science as focusing on micro processes enables to compare science to other industries.

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Table 1: Presentation of the cases

Team	**Alpha**	**Beta**	**Gamma**	**Delta**	**Epsilon**	**Omega**	**Total**
Specialty	Understanding the toxicity of the nanoparticles with human, mammalian and fish cells, and algae.	Studying the chemical interactions on semiconductors surfaces in order to improve their electrical properties	Understanding the electromagnetic properties of certain nanoparticles through computational simulation	Understanding how nanoparticles behave within human cells in order to use this properties to cure diseases	Investigating the growth and the study of semiconductors and nanostructures by using multiple characterisation techniques	Studying the electronic, chemical and structural properties of semiconductor surfaces by using radiation source	
Environment	multidisciplinary	monodisciplinary	monodisciplinary	multidisciplinary	monodisciplinary	monodisciplinary	
Research	experimental	experimental	Both simulation and theoretical work	experimental	experimental	experimental	
New entity	yes	no	yes	yes	no	no	
Professor	1*	1*	1*	1*			**4***
Lecturer	1				1*	1*	**2***
Postdocs	2	1	6	5		1	**15**
PhDs	6	2	3	1	3	3	**18**
total	**10**	**4**	**10**	**7**	**4**	**5**	**40**

* Team leader

Table 2: Presentation of the external stakeholders

Bodies	**Policy makers**	**Funding agencies**				**Total**
		Academe	Industry	Environment	European Commission	
Role	Establishing the main directives for nanoscience and nanotechnology, and science and technology in general	Funding academic research project mainly in the areas of biotechnology, information and communication technology and energy	Supporting companies and funding academic research project that aim at developing and/or to transfer a technology into industry	Funding projects that create knowledge and expertise in the area of environment and health, water quality and waste management	Funding projects that fall under the category of nanoscience, nanotechnology, materials and new technologies	
nano	2	1	3*	1	3*	6
S&T policy	1					1
Total	**3**	**1**	**3**	**1**		**8**

* The three interviewees in charge of the development of nanotechnology and technology transfer with industry are also the national delegates for the European Seventh Framework Programme. They thus have been interviewed in quality of both roles.

Figure 1: Data Structure

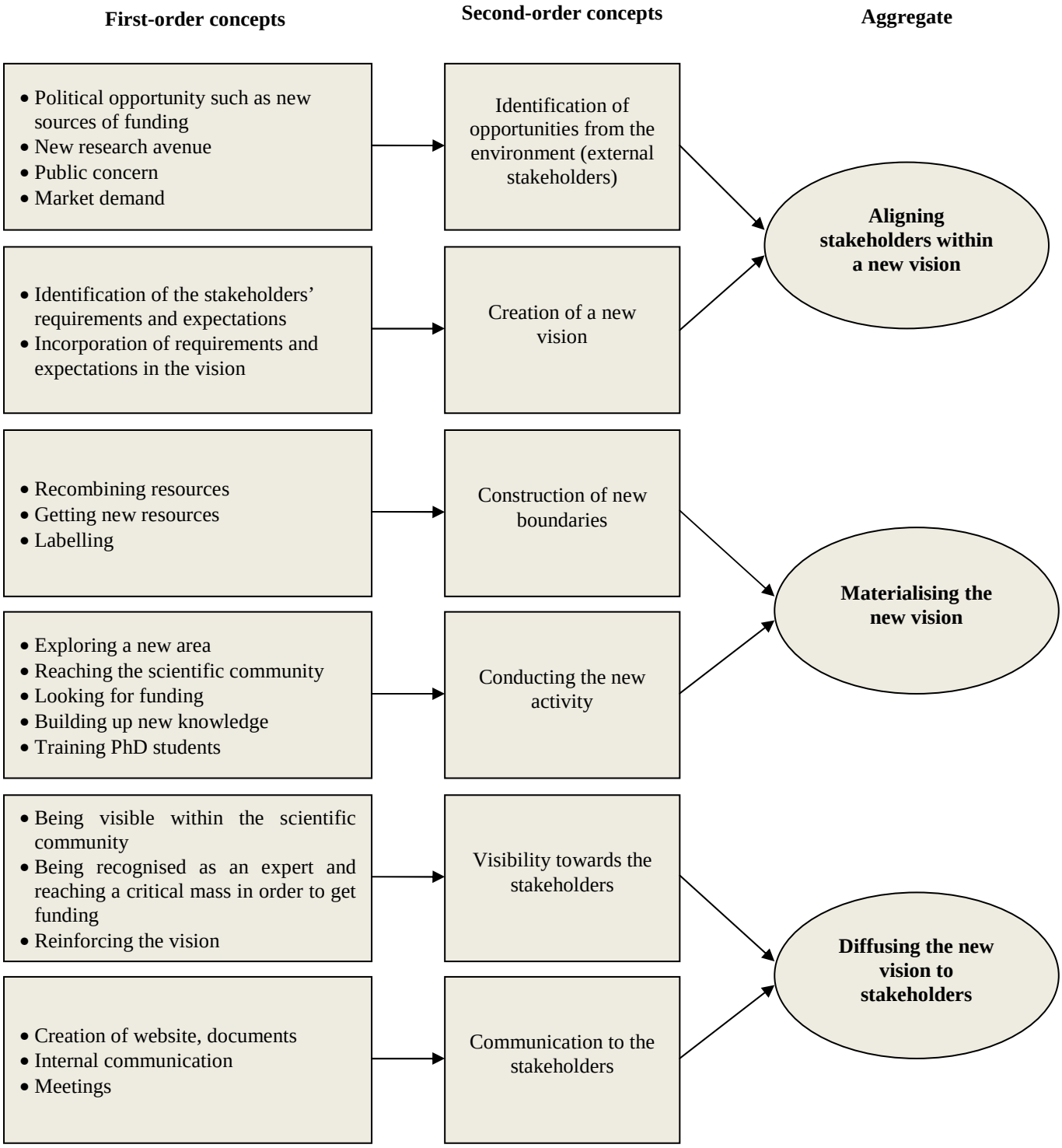

Figure 2: Sensemaking and sensegiving as intertwined processes